Conductive G-Quadruplex Hydrogels for Cardiac Tissue Regeneration

Improving preventive strategies for cardiovascular diseases is a significant concern within the field of regenerative medicine. Thereby, the bio-inspired hydrogel matrices have demonstrated a broad range of applications, from facilitating cell encapsulation in advanced 3D cultures and tissue models to supporting cell-based therapeutics and tissue engineering. With this, we aim to develop bio-inspired injectable hydrogel scaffold to provide a regenerative microenvironment for cardiac tissue regeneration. Our approach is to synthesize injectable hydrogen-bonded self-assembled small biomolecules guanosine-quadruplex (GQ) hydrogel scaffold. G-quadruplexes, prevalent four-stranded supramolecular structures, have garnered significant attention due to their unique self-assembly and diverse biological functions. These structures are commonly found in guanine-rich DNA and RNA sequences within cells. We envisioned that the bio-inspired GQ-based hydrogels having close alignment with cells will promote the recovery of cardiac functioning through tissue regeneration.

In this project, we will develop conductive GQ hydrogels and use them as cell scaffolds within engineered heart tissue (EHT) devices. Developing robust, responsive bio-inspired hydrogels for the delivery of cells will serve a non-invasive strategy in the field of cardiac tissue regeneration. The unique conductive and hierarchical 3D fibrous network, along with the excellent biocompatibility of GQ hydrogels, will support cardiac cell culture. The proposed physically crosslinked 3D hydrogel scaffold with *in situ* self-assembling phenomenon contributes to the responsive and rapid gelation at the site of treatment. The outcomes of this project will expand possibilities for pre-clinical 3D cardiac tissue models, opening avenues for drug screening and personalized cardiovascular medicine.

This project includes the following exposures for the student.

- Synthesis of conductive GQ hydrogels
- Hydrogel characterization: including mechanical-rheological studies, conductive properties and biological studies.
- Investigation of cell biology applications, we will evaluate the GQ hydrogel materials for 3D cell culture, including their potential in promoting cardiac tissue regeneration.

References:

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